Pacific Gas & Electric Company

California Emerging Clean Air Technology Forum

Stationary Source Session - Energy Generation From Digesters

Merced, CA

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Introduction

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- Senior Project Manager, Business Development, Gas Transmission and Distribution
- Responsibilities include the development of new gas-related business opportunities with a specific focus on dairy biomethane to pipeline injection projects
- Also working on projects involving the digestion of food waste and municipal wastewater
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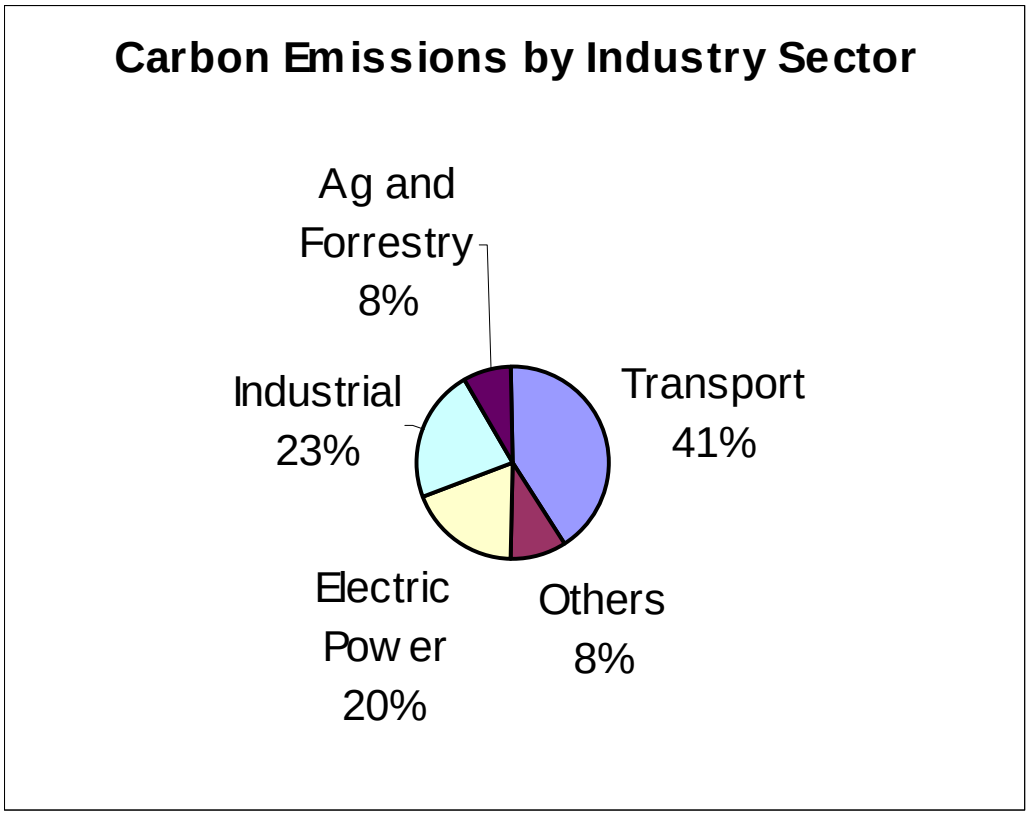
Climate Change – CA Greenhouse Gas Emissions

1.8 million dairy cows on 1900 farms each producing 100 pounds of waste daily (90,000 tons per day in California)



- Methane is 21 times more potent a greenhouse gas than CO2
- Reduce greenhouse gas and volatile organic compound emissions on the dairy
- Digest manure to create biogas, a renewable energy supply

Anaerobic Digestion Process

Anaerobic Digestion Process – Proven available technology common in Europe

- Digester types – microbes break down waste in a constant continuous process
  - Lagoon digester - less expensive, 35-40 days
  - Plug Flow – not too common in US
  - Tank digester – more expensive, 20-25 days
- Collect manure – flush (lagoon) or scrape gathering (tank)
- Separate solids as needed
- Digested biogas is 60% methane, but has impurities such as 39.5% CO2, and 0.5% H2S/other

Uses of Biomethane

What is “biomethane”?

- Biogas with impurities and inert gases cleaned (or scrubbed) out
- Degree of scrubbing depends on intended use of biomethane

End uses of biomethane

- Onsite Electric Generation
- Deliver into gas transportation pipeline
- Other potential uses are flaring, CNG/LNG as vehicle fuel, and fuel cells

Onsite Electric Generation

Use biogas to generate electricity on the dairy

- Decrease energy costs through self-generation
  - Use all power on dairy, sell all power to utility, or use what you need and sell excess
- Generally economic even for smaller farms
- Be sure to have your digester and generator sized for your dairy and your business plan
  - Historically, oversized digesters caused serious problems under net metering tariffs
- Zero to moderate biogas scrubbing depending on generation equipment
  - H2S is highly corrosive to machines
- CARB limits NOx to 9 ppm for new systems
  - “Grandfathered” systems are under review

Biomethane Injection to Pipeline

Deliver biomethane into gas transmission pipeline

- PG&E will accept biomethane from animal and agricultural waste into its gas transmission pipeline system
- Transport gas to any end-use customers designated by gas supplier
- Developer may sell to any end-user, not necessarily PG&E
- Biomethane must be fungible with gas in interconnecting pipeline

Biomethane Injection to Pipeline - Roles

- Project developer will
  - handle economic analyses, planning, and permitting
  - contact utility for gas transmission pipeline interconnection and electric facilities
  - build digester, scrubber, flare, piping, compression
- PG&E will
  - facilitate the project (does not own or operate)
  - provide metering and interconnection tap for larger projects (>500Mcf/day) at PG&E expense
  - test and monitor for gas quality requirements
  - transport biomethane to the market – open access to system, least cost transportation tariff
  - compete with other parties to purchase the biomethane

Biomethane Injection to Pipeline - Benefits

Good for the dairyman

- Provides dairy with new continual revenue sources, including gas commodity sales, renewable energy credits, and greenhouse gas reduction credits
- Negotiate biogas sales contract with any interested buyer
- Significant reduction of greenhouse gas emissions at dairy
- Additional tool for manure and odor management

Good for PG&E

- Reliable renewable gas supply for California – 20% by 2010
- Most efficient use of biogas for generating electricity
- Dispatchable from storage
- Utilizes existing transmission pipeline infrastructure

Biogas to Pipeline Injection – Challenges and Solutions

Proximity to Transmission Pipelines (2-3 miles)

- Gathering systems to high density areas (EPA/PG&E study)

Capital and Operating Costs

- Minimum dairy cows: 3-4,000 for lagoons and 8-10,000 for tanks
- May not be economic for single smaller dairies (Community Digestion)
- Develop state and federal grants/tax credits/loans, electric tariff changes

Gas Quality

- Must meet PG&E's Gas Rule 21.C (living document)
- Perform gas quality testing for co-digestion with organic waste

Regulatory Hurdles (Permitting)

- Bioenergy Interagency Working Group

Biogas to Pipeline Injection - Current Projects

- Bioenergy Solutions - Vintage Dairy
  - 1st in California and 3rd in United States to inject biomethane
  - Gas injection beginning in July
  - Additional customer agreements signed, targeted online 1Q09
- Microgy – 7 dairies in Fresno and Kings Counties
  - Permits approved, construction starting in July
  - target launch dates in 2Q09
- A significant number of other California projects in discussion phase
- Contract negotiations underway with dairies east of California


Vintage Dairy Lagoon Digester
Under Construction

Vintage Dairy Lagoon Digester Covered and Producing Gas


Dairy Facilities
Lagoon
H2S Scrubber
Control Shed
CO2 Scrubber
Flare Stack


PG&E Facilities
Dairy Facilities
Compressor, Chiller, Monitor
Metering and Pipeline Interconnection

Thank You

Q & A